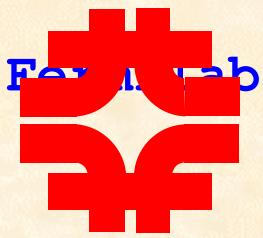




Recycler BPM Front-end

Duane C. Voy
voy@fnal.gov



General Issues

Pilot Test: operates identically to old system

Installation & Commissioning: operates similarly to existing system

- * Ultimately: event driven system

Support ring and transfer line detectors

Transfer line specifications identical to 2.5 MHz bunched beam Flash

- * All measurements provide position and intensity proportional (sum signal) data

- * All measurements support multiple beam “flavors”

Readout provided for all settable parameters

Detailed status provided for each measurement and for overall BPM operation

References:

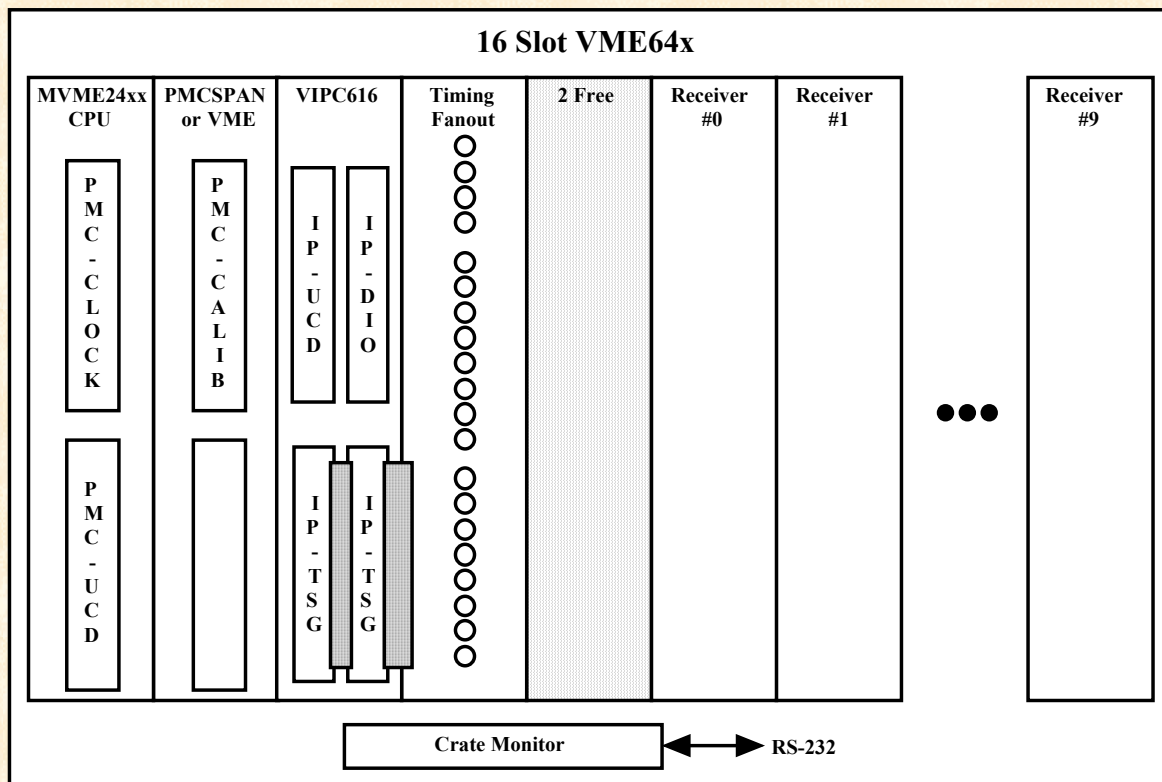
“Recycler BPM Embedded Software Description” – Old System

“Recycler BPM Front-end Technical Requirements” - **TBC**

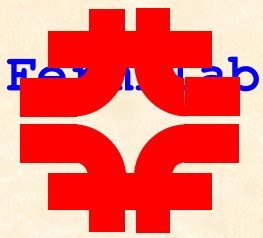
“Recycler BPM Front-end Technical Specification” – **TBC**



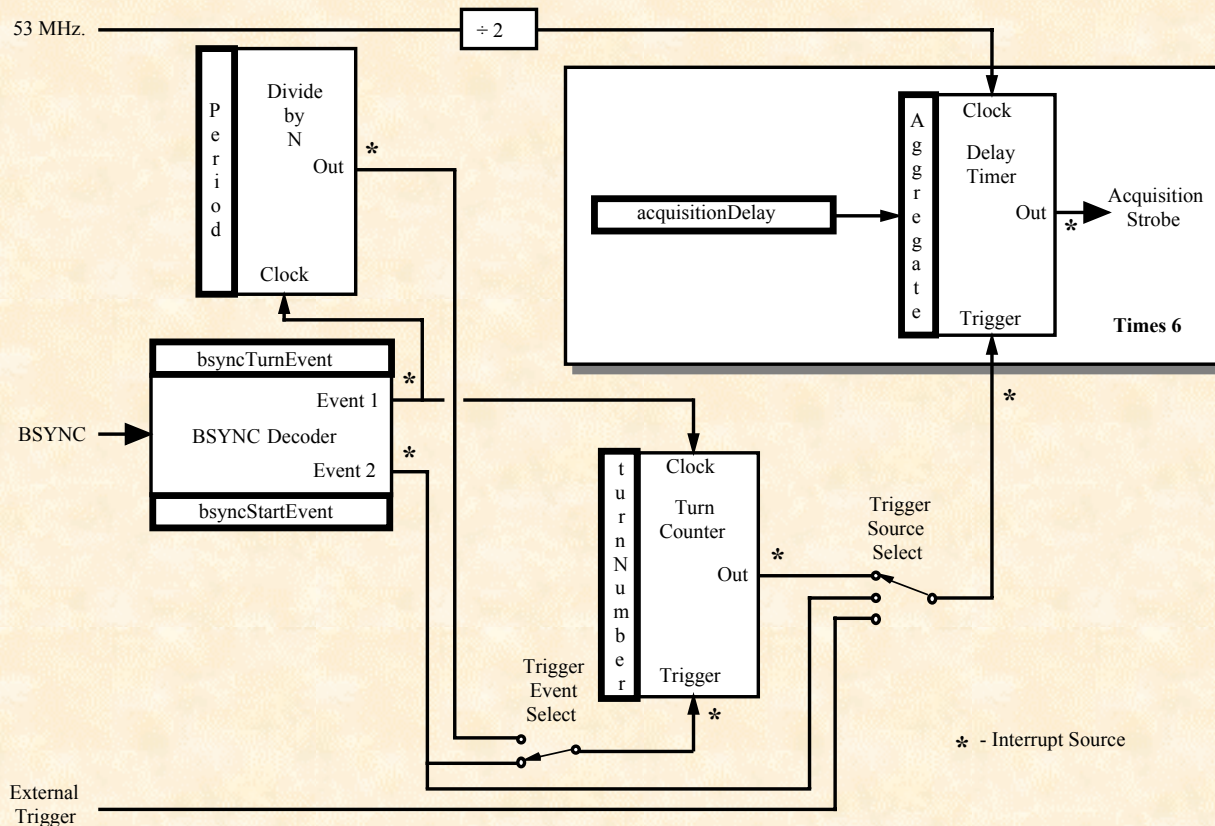
Recycler BPM Front-end*

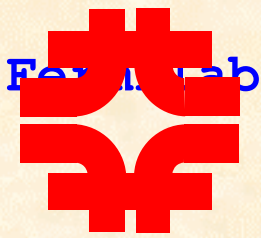


* Not drawn to scale.



Recycler BPM Timing Signal Generator





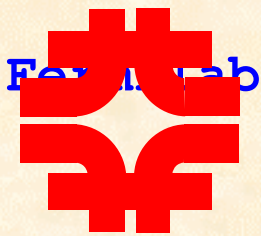
Measurement Timing

All measurements:

- * Armed by a control console request or a specified Tclk event
Triggered by a specified Bsync event
- * Delayed from specified turn marker by Mdat derived value + specified offset
Over-write last data of same type (except Background Flash)
Timeout in five minutes if not triggered
Restore any interrupted Background Flash
- * If not yet triggered are aborted by new incoming arm event
- * One deep command buffer allows triggered measurements to complete
All data buffers also contain relevant time-stamp, status and parameter set

Global physics parameters:

- * proton/pbar/injection/extraction/MainInjector/Accumulator/calibration
- * bunched/de-bunched
- * bunch/batch/ensemble/head/tail
Mdat type code
global delay



Beam Measurements

- * 1) Background Flash - programmable rate – 200 .. **TBD** Hz.
 - Default mode when no other measurement active
 - Quasi-continuous - momentarily interrupted by other measurements
- * Circular buffer of 16384 elements
 - triggered by **TBD** external pulse
 - restart upon control console request
 - Fast time plot most recent values even when circular buffer stopped
 - Restart when circular buffer is reset
- * 2) Flash - first/last turn
- * Derived from Turn-by-turn data
- * 3) Closed Orbit - averages 2 .. **TBD** samples
- * Derived from Turn-by-turn data
- * 4) Turn-by-turn - measures 1 .. 1024 consecutive turns
- * 5) Calibration
 - Uses normal measurement data paths
 - Check of signal path and software processing
 - Store results in database
- * 6) Diagnostic
 - Returns raw A/D counts and digital receiver I&Q values



* Beam “Flavors”

2.5 MHz bunched Injected/Extracted Beam

Individual bunch – BF, CO, FL, TbT

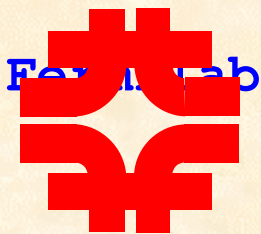
Batch average - BF, CO, FL, TbT

De-bunched Hot/Cold Beam

Head - BF, CO, FL, TbT

Tail - BF, CO, FL, TbT

Ensemble center-of-mass - BF, CO



* Event Triggered Data Acquisition

Measurement armed by Tclk event (or control console request)

Measurement triggered by Bsync event

Up to 16 arm/trigger Acquisition Specifications containing:

- Tclk arm event number

- Bsync trigger event number

- Mdat address

- Global delay

- Enable/Disable flag

- Proton/Pbar/Injection/Extraction/Calibration

- Bunch/Batch/Ensemble/Head/Tail

- Timeout value

One data buffer per Acquisition Specification

Data readout via Readout Specification containing:

- Trigger event identifier

- Type of data desired

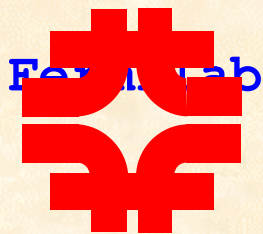
- Turn number

- Number of turns

- Channel pair (for Turn-by-turn)

References:

“Event Driven Data Acquisition for the Recycler Ring BPM”



Data Readout

Data Types:

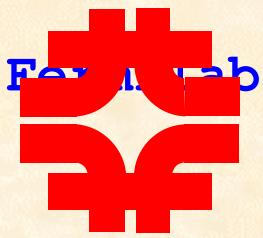
- 1) Background Flash
- 2) Flash
- 3) Closed Orbit
- 4) Turn-by-turn
- * 5) Diagnostic

All Buffers:

Independent readout of:

Position

- * Intensity proportional (sum signal)
- Specified number of turns (Turn-by-turn)
- Associated status, parameter set and time-stamp



Application Programs

Application Program Support Library

- * intensity
- * turn-by-turn on all channels
- * event triggered capability

Flash Application

- * intensity
- * event triggered capability

Turn-by-turn Application

- * intensity
- * turn-by-turn on all channels
- * event triggered capability

- * Calibration Application

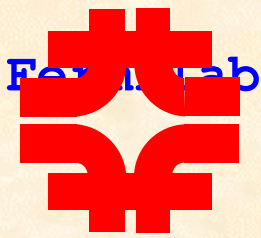
Request measurements

Analyze, display and store data - user friendly

- * Engineering Support Application

Request and display diagnostic data

Set and readout engineering parameters



Software Projects

Front-end Modules:

Main front-end – Duane Voy

- * Digital Receiver Processing– Charles Briegel
- * Receiver Clock – Dennis Nicklaus
- * Calibration Waveform Generator – Dennis Nicklaus
- * Event Triggered Data Acquisition – Duane Voy

Application Programs:

Application Support Libraries – Brian Hendricks

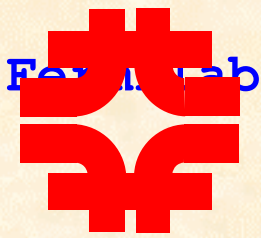
Flash Measurement – Lin Winterowd

Turn-by-turn Measurement – Ming-Jen Yang

- * Calibration – Stephen Pordes & **TBD** - CD
- * Engineering Support **TBD** – CD

References:

“Recycler BPM Software Outline”



Software Development Plan

1 - Provide Functionality of Current 2.5 MHz System

- Port front-end to VxWorks 5.4 on PowerPC

- ADC software module for digital receiver

- Digital receiver clock

2 – Enhance Existing Functionality

- Calibration system

- Diagnostic measurement

- Intensity proportional (sum signal)

- Turn-by-turn for all channels

- Engineering parameters in ACNET

3 – Implement New Modes/Measurements

- Multiple digital receiver filter management

- Background Flash circular buffer

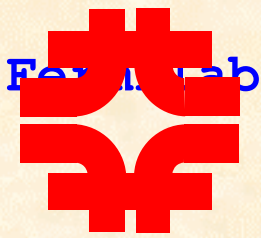
4 – Implement Event Triggered Data Acquisition

- Tclk event handler

- Acquisition and Readout specifications

References:

- “Recycler BPM Software Priorities & Projects”



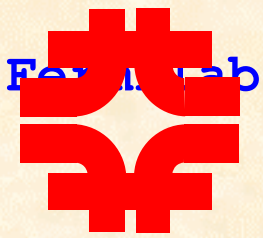
Software Development Plan

Front-end Software

- First Installation and Pilot Test
 - Port front-end to VxWorks 5.4 on PowerPC
 - ADC software module for digital receiver
 - Digital receiver clock
 - Local calibration signal control
 - Local diagnostic measurement
- System Commissioning
 - Calibration signal control in ACNET
 - Diagnostic measurement in ACNET
 - Engineering parameters in ACNET
- Early Operation
 - Intensity proportional (sum signal) data
 - Turn-by-turn data for all channels
 - Multiple digital receiver filter management
- Full Operation as Specified
 - Background Flash circular buffer
 - Tclk event handler
 - Acquisition and Readout specifications

Application Software

- First Installation and Pilot Test
- System Commissioning
 - Calibration Application
 - Engineering Support Application
- Early Operation
 - Intensity proportional (sum signal)
 - Turn-by-turn for all channels
 - Multiple digital receiver filter management
- Full Operation as Specified
 - Acquisition and Readout specifications



Software Development Plan

